Lifecycle Phases

The CMS IT Investment Management Process consists of three primary phases: IT Investment Selection Phase, IT Investment Implementation Phase, and IT Investment Evaluation Phase. These three phases are based on the conceptual framework laid out in the Government Accountability Office's (GAO) February 1997 *Assessing Risks and Returns: A Guide for Evaluating Federal Agencies' IT Investment Decision-making*.

Each of these three investment management phases are further partitioned or aligned with the phases of the system lifecycle, as follows:

1.0 IT Investment Selection Phase

1.1 Business Case Analysis Phase

2.0 IT Investment Implementation Phase

2.1 Requirements Analysis Phase
2.2 Design &Engineering Phase
2.3 Development Phase
2.4 Implementation & Testing Phase
2.5 Initial part of Operations & Maintenance Phase

3.0 IT Investment Evaluation Phase

3.1 Later part of Operations & Maintenance Phase
3.2 Disposition Phase

Regardless of the system development methodology that is employed for a given IT project, the primary activities performed throughout the system life cycle generally remain the same, and are often referred-to collectively in terms of the above phases. While the phases of the life cycle are graphically depicted in sequential order within the CMS Integrated IT Investment & System Life Cycle Framework (reference Life Cycle Overview Graphic), some of the phases may overlap on some projects or may occur iteratively for other projects, depending on the system development methodology selected for the project. For guidance in choosing an appropriate system development methodology, see Selecting a Development Approach.

IT Investment Selection Phase

Summary Description:

The IT Investment Selection Phase is the first step in the CMS IT Investment Management Process, which seeks to ensure that only sound and viable investments are included in the CMS IT Investment Portfolio, such that these are the only ones that will receive appropriate funding.

Only those proposed IT investments that meet the following criteria are considered acceptable to CMS:

- Aligned with strategic CMS business objectives and priorities;
- Positive return on investment (as determined by analysis of project costs and benefits);
- Acceptable level of risk (especially with regard to an assessment of business and security risks), with an appropriate risk mitigation strategy;
- Acceptable technical strategy, compliant with CMS' Enterprise Architecture; and
- Acceptable acquisition strategy.

During the IT Investment Selection Phase, an IT investment is classified as Major, Non-Major, or Un-funded. See "Major" IT Investment/Project for the criteria used to classify an investment as major.

Non-Major investments are those that do not meet any of the Major criteria, and Un-funded projects are those that are not approved for funding.

The classification of an IT investment serves as a critical factor in determining the specific tasks, activities, milestones (e.g., reviews), and artifacts that the IT investment must complete during the remainder of the IT investment's life cycle.

Alignment with the System Life Cycle:

The IT Investment Selection Phase encompasses all of the tasks, activities, milestones (e.g., reviews) and artifacts associated with the Business Case Analysis Phase.

Decision Milestones:

The primary decision milestone that occurs during the IT Investment Selection Phase is the Investment Selection Review (ISR). All IT investments must pass the ISR checkpoint before proceeding to the next phase in the investment and system lifecycles.

IT Investment Implementation Phase

Summary Description:

The IT Investment Implementation Phase is the second step in the CMS IT Investment Management Process. Once an IT investment is approved by CMS' Information Technology Investment Review Board (ITIRB)/Financial Management Investment Board (FMIB), it is to be managed and implemented in a structured manner, using sound project management practices, and ensuring involvement by business stakeholders and technical experts throughout the IT investment's remaining life cycle.

A critical aspect of managing "Major" IT investments is effectively managing the projects that comprise the investments. This is to include the decomposition of the planned work effort into discrete phases and/or increments, tasks, activities, milestones, and artifacts necessary to accomplish project objectives that can be measured based on associated time (e.g., duration and start/finish dates), resources, costs and elemental dependencies (e.g., leads and lags, assumptions, and constraints) applied to each element, and from which a critical path can be identified for the project.

Each approved CMS IT investment/project must ensure the following:

- Compliance of the designated IT Project Owner/Manager with Office of Management & Budget (OMB) project management qualification guidance;
- Compliance of the proposed solution with CMS' Enterprise Architecture;
- Compliance with sound systems development life cycle and/or project management processes and practices (including implementation of adequate quality assurance and risk management initiatives);
- Compliance with applicable CMS systems security standards and requirements;
- Compliance with applicable Federal requirements concerning privacy compliance and the proper collection, storage, and sharing of data; and
- Compliance with applicable CMS infrastructure management standards and requirements.

Appropriate management action is also to be taken to ensure continued viability of the CMS IT investment as assessed by compliance with established scope, budget, schedule, and performance measures. All approved "Major" IT investments are subject to ongoing monitoring to ensure that potential problems that may result in additional costs, slippage in schedule, scope changes, or quality issues are identified and addressed in corrective action plans that are implemented as early in the life of the investment as is possible.

Alignment with the System Life Cycle:

The IT Investment Implementation Phase encompasses all of the tasks, activities, milestones (e.g., reviews), and artifacts associated with the following system life cycle phases:

Requirements Analysis Phase
Design & Engineering Phase

Development Phase
Implementation & Testing Phase
Initial part of the Operations & Maintenance Phase

Decision Milestones:

There are two primary decision milestones that occur during the IT Investment Implementation Phase for generally all IT investments:

Preliminary Design Review (PDR)
Operational Readiness Review (ORR)

IT Investment Evaluation Phase

Summary Description:

The IT Investment Evaluation Phase is the third and last step in the CMS IT Investment Management Process, which seeks to determine how well an IT investment/project that has moved into the Operations & Maintenance Phase of its life cycle, achieved the business objectives set forth during the initial Business Case Analysis Phase. The focus of this post-implementation assessment is to measure the performance of the IT investment/project against the proposed outcomes, to determine if subsequent investment action is appropriate.

IT investment management consists of not only analyzing the return on investment achieved from individual IT investments/projects, but also across all IT investments/projects that collectively comprise the entire CMS IT portfolio, in order to communicate the strategic value of IT to the enterprise as a whole. Portfolio management provides practical information designed to help understand investment planning and meet the capital planning and reporting demands set forth by Congress, the President's Management Agenda, the Office of Management and Budget (OMB), and the Clinger-Cohen Act.

The focus of CMS' portfolio management philosophy is on two main components: choosing and executing. On the choosing side, CMS' focus is on selecting the right portfolio of IT investments to ensure that CMS is investing its money and resources on the right things. On the executing side, CMS' focus is on regularly communicating on the status of IT investments in a language that everyone can understand and making changes to the IT investment as needed so as to keep CMS doing the right things well. It is during the IT Investment Evaluation Phase that CMS seeks to determine if and when it is appropriate to consider beginning the life cycle again for potential investments in major new enhancements (redesigns) to existing automated systems an/or to appropriately dispose of antiquated (i.e., legacy) systems.

Alignment with the System Life Cycle:

The IT Investment Evaluation Phase encompasses all of the activities and milestones associated with the later stages of the Operations & Maintenance Phase, as well as all of the Disposition Phase.

Decision Milestones:

Although there are no formal decision milestones that are defined in the CMS Integrated IT Investment & System Life Cycle Framework for the IT Investment Evaluation Phase, performance measurements are regularly conducted as part of the annual budget process for measuring how well an IT investment/project continues to support the mission of CMS, taking into account architectural progress, technology changes, security and privacy concerns.

Business Case Analysis Phase

Summary Description:

The Business Case Analysis Phase is the first step in the CMS system life cycle, during which basic information about the IT investment/project is documented in an initial IT Fact Sheet (e.g., project description, prevailing business need, projected cost for the current fiscal year and at least two successive fiscal years, anticipated benefits, major milestones and timeline, potential technical strategies, performance measures, potential risk, and a spending plan).

A Business Case Analysis (BCA) is also generally required that provides necessary information concerning the scope of the IT investment/project, alternatives considered, estimated costs and return on investment, risks, and technical and acquisition strategies necessary for informed investment decision-making. The BCA also includes mandatory high-level business requirements and a business risk assessment.

A user-oriented description of the automated system should also be prepared as a part of the BCA or as a separate Concept of Operations document to describe characteristics of the proposed automated system from the user's viewpoint to ensure a clear understanding of the proposed automated system and to help achieve early buy-in from users, customers, and stakeholders.

Alignment with the Investment Life Cycle:

The Business Case Analysis Phase encompasses all of the tasks, activities, milestones (e.g., reviews), and artifacts that are also associated with the IT Investment Selection Phase of the CMS investment life cycle.

Artifacts:

The completion of an initial IT Fact Sheet and a Business Case Analysis (BCA) are artifacts that are generally required for all IT investments/projects to support decision-making activities during the IT Investment Selection Phase of the IT Investment Management Process. A separate Concept of Operations (ConOps) document may also be an appropriate and necessary artifact for many IT projects.

Reviews:

The primary decision milestone or review that occurs at the end of the Business Case Analysis Phase is the Investment Selection Review (ISR). All IT investments/projects must pass the ISR checkpoint before proceeding to the next phase in the investment and system life cycles.

Requirements Analysis Phase

The Requirements Analysis Phase is the second step in the CMS system life cycle. During the Requirements Analysis Phase, the business requirements that were documented in the Business Case Analysis (BCA) are further analyzed and decomposed into functional and non-functional requirements, events and scenarios. If appropriate, a logical depiction of the data entities, relationships and attributes of the automated system is also created.

Alignment with the Investment Life Cycle:

The Requirements Analysis Phase is the first of five sub-phases that collectively comprise the IT Investment Implementation Phase of the CMS investment life cycle.

Artifacts:

The completion of a Requirements Document is the primary artifact produced during the Requirements Analysis Phase. In addition, a Logical Data Model may also likely be required.

For those automated systems where privacy compliance is a concern, a System of Records (SOR) should be initiated during the Requirements Analysis Phase so that it can be baselined and ready to begin the clearance process during the Design & Engineering Phase.

In addition, work should also begin on preparing the System Security Plan (SSP) and/or Information Security Risk Assessment that is to be initially baselined during the Design & Engineering Phase.

Reviews:

The primary decision milestone or review that occurs at the end of the Requirements Analysis Phase as an encouraged best practice is the Requirements Review.

Design & Engineering Phase

Summary Description:

The Design & Engineering Phase is the third step in the system life cycle that seeks to develop detailed specifications that emphasize the physical solution to the user's information technology needs.

During the Design & Engineering Phase, the functional and non-functional requirements, events and scenarios documented in the Requirements Document and the logical description of the entities, relationships, and attributes of the data depicted in the Logical Data Model are further refined into system and subsystem, program, and database specifications that are organized in a way suitable for implementation within the constraints of a physical environment (e.g., computer, database, facilities) that is compliant with the CMS Enterprise Architecture and CMS Design Standards.

In refining the requirements, system processes and associated required data are allocated to subsystems based on the following considerations:

- System/subsystem functions
- Accuracy and validity imposed on the system/subsystem
- Timing requirements placed on the system/subsystem
- Adaptability of the system/subsystem to changing requirements
- Equipment needs
- Communications environment
- Support software
- System security and controls
- Input and output records

The lowest level functions identified in the system/subsystem specifications are then used to develop program specifications based on the physical constraints. Program processes and associated required data are allocated to programs based on:

- Functions of the software units
- Accuracy and validity imposed on the software units
- Timing requirements placed on the software units
- Support software with which the software units must interact
- Interfaces with other application software
- Storage requirements
- Security requirements
- Input and output data and output reports
- Data retention
- Logic of each software unit

The data requirements and models are also refined into database specifications based on the physical constraints and the following considerations:

- Special instructions for database usage
- Support software requirements
- Security and privacy considerations, sensitivities, and critical issues
- Database management system configuration
- Database schema

During the Design & Engineering Phase, the initial strategy for implementation and testing and the training approach are also begun. Estimates of project expenses for the Design & Engineering Phase are updated to reflect actual costs and estimates for future phases. In addition, the work planned for future phases is redefined based on information acquired during the Design & Engineering Phase.

Alignment with the Investment Life Cycle:

The Design & Engineering Phase is the second of five sub-phases that collectively comprise the IT Investment Implementation Phase of the CMS investment life cycle.

Artifacts:

A System Design Document (SDD) and an Information Security Risk Assessment are the primary artifacts produced during the Design & Engineering Phase. In some cases, a System Security Plan (SSP) may also need to be enhanced or created.

Additional artifacts that may be required or appropriate include:

Interface Control Document (ICD)
Database Design Document
Data Conversion Plan
Release Plan

For those automated systems where privacy compliance is a concern, the System of Records (SOR) is finalized and begins the associated formal review and clearance process. If appropriate, a Computer Match Agreement (CMA) may also need to be prepared and formally reviewed/cleared.

During the Design & Engineering Phase, initial work should also begin on the following artifacts, as required or appropriate, so that the artifacts will be ready to be baselined during the subsequent Development Phase:
Implementation Plan
Test Plan
Test Case Specification
User Manual
Training Plan

Reviews:

The primary decision milestone or review that occurs during the Design & Engineering Phase is the Preliminary Design Review (PDR). All system development and major application enhancement projects (including GOTS and/or COTS integrations) must pass

the PDR checkpoint before proceeding to the next phase in the system life cycle. An additional review that may be required or encouraged as a best practice at the end of the Design & Engineering Phase is the Detailed Design Review.

Development Phase

The Development Phase is the fourth step in the system life cycle during which the System Developer takes the detailed logical information provided in the System Design Document (SDD), Interface Control Document (ICD), Database Design Document, Data Conversion Plan, and Release Plan and transforms it into machine-executable form, and ensures that all of the individual components of the automated system function correctly and interface properly with other components within the system.

As necessary and appropriate, system hardware, networking and telecommunications equipment, and COTS/GOTS software is acquired. New custom-software programs are developed, database(s) are built, and software components (COTS, GOTS, and custom-developed software and databases) are integrated. Test data and test case specifications are finalized, and unit and integration testing is performed at the System Developer's location with test results appropriately documented. Data conversion and training plans are finalized and user procedures are baselined, while operations, office and maintenance procedures are also initially developed.

Alignment with the Investment Life Cycle:

The Development Phase is the third of five sub-phases that collectively comprise the IT Investment Implementation Phase of the CMS investment life cycle.

Artifacts:

The following are the primary artifacts that are produced during the Development Phase:

Code
Version Description Document
Implementation Plan
Test Plan

Additional artifacts that may be required or appropriate include:

Test Case Specification
Training Plan
User Manual

Continued enhancements are also made to the System Security Plan (SSP) and/or Information Security Risk Assessment and the Data Conversion Plan as necessary and appropriate during the Development Phase.

Reviews:

There are two decision milestones or reviews that may be required or encouraged as a best practice at the end of the Development Phase:

Validation Readiness Review (VRR)
Implementation Readiness Review (IRR)

Implementation & Testing Phase

The Implementation & Testing Phase is the fifth step in the system life cycle during which the automated system is installed and fully tested at the prescribed CMS location based on the Code, Version Description Document, Implementation Plan, Data Conversion Plan, Test Plan, and Test Case Specification, as appropriate.

During the Implementation & Testing Phase, the required system hardware, networking and telecommunications equipment; COTS, GOTS, and/or custom-developed software; and database(s) are installed in the CMS test and/or production environments.

The physically implemented database is tested and verified before any live data is added, focusing on such items as the following:

- Security and privacy of the data
- Database performance
- Considerations for operating the database on the target platform
- File and database sizing
- Data backup and recovery

User and system acceptance testing is performed on the automated system to measure the system's ability to perform the functions that are required by the user and to ensure an acceptable level of performance. The classes of tests listed below provide a general description of the testing that is executed during this phase:

- Requirements Validation
- Functional Testing
- Performance/Volume/Stress Testing
- Security Testing
- Ease of Use
- Operational Testing
- Documentation Testing
- Procedure Testing
- Interface Testing

During the Implementation & Testing Phase, results from all of the testing are documented in a formal Test Summary Report. User procedures, the training approach and associated materials, and operations and maintenance documentation are also finalized during the Implementation & Testing Phase. Existing office procedures are updated or new ones are created to accommodate any impact that may occur from operation of the automated system.

At the end of the Implementation & Testing Phase, a clear indication of the system's readiness for operation is evident. The automated system is certified and accredited based on its fitness for use in a production environment as determined by review and approval of the Test Summary Report, completion of all required artifacts and reviews, and the final approval of the System Security Plan (SSP) and/or Information Security Risk Assessment.

Alignment with the Investment Life Cycle:

The Implementation & Testing Phase is the fourth of five sub-phases that collectively comprise the IT Investment Implementation Phase of the CMS investment life cycle.

Artifacts:

The following are the primary artifacts that are produced during the Implementation & Testing Phase:

Test Summary Report
Operator Manual
Training Artifacts

If required, the System of Records (SOR) and Computer Match Agreement (CMA) must also have completed the clearance process by the end of the Implementation & Testing Phase.

Additionally, the System Security Plan (SSP) and/or Information Security Risk Assessment must also have been certified and accredited by the end of the Implementation & Testing Phase.

If a User Manual was created during the system life cycle, then it too must be in its final, approved form.

Reviews:

There are three required decision milestones or reviews that occur during the Implementation & Testing Phase:

System Certification
System Accreditation
Operational Readiness Review (ORR)

All system development and major application enhancement projects (including GOTS and/or COTS integrations) must pass the ORR checkpoint before proceeding to the next phase in the system life cycle.

Operations & Maintenance Phase

The Operations & Maintenance Phase is the sixth step in the system life cycle during which the certified and accredited system is released into the full-scale production environment for sustained use and operations/maintenance support based on the User Manual, if available, and the Operator Manual. All necessary training for using the system is also accomplished during this phase based on the Training Plan and Training Artifacts, if appropriate.

During the Operations & Maintenance Phase, change requests and problem reports may continually be generated and resolved. Periodically the automated system will also need to be re-certified and re-accredited for continued operation in the production environment.

When the time comes that the automated system will no longer be needed or will be replaced, then a System Disposition Plan must be prepared and approved prior to final disposition of the system.

Alignment with the Investment Life Cycle:

The Operations & Maintenance Phase is the last of the five sub-phases that collectively comprise the IT Investment Implementation Phase of the CMS investment life cycle. The Operations & Maintenance Phase also encompasses some of the tasks, activities, milestones (e.g., reviews), and artifacts that are associated with the initial part of the IT Investment Evaluation Phase of the CMS investment life cycle.

Artifacts:

The following are the primary artifacts that are produced during the Operations & Maintenance Phase:

Change Requests
Problem Reports
System Disposition Plan.

Reviews:

There are two required decision milestones or reviews that occur during the Operations & Maintenance Phase:

System Re-Certification
System Re-Accreditation

Disposition Phase

The Disposition Phase is the seventh and final step in the system life cycle during which the automated system is formally retired and ceases to exist as an operational system. Disposition of the automated system occurs based on the System Disposition Plan that was established during the Operations & Maintenance Phase.

The disposition activities ensure the orderly termination of the automated system and preserve vital information about the system so that some or all of the information may be reactivated in the future if necessary. Particular emphasis is given to proper preservation of the data processed by the system, so that the data is effectively migrated to another system or archived in accordance with applicable records management regulations and policies for potential future access.

Alignment with the Investment Life Cycle:

The Disposition Phase is the last sub-phase of the IT Investment Evaluation Phase of the CMS investment life cycle.

Artifacts:

There are currently no artifacts identified for creation during the Disposition Phase.

Reviews:

There are currently no decision milestones or reviews identified to occur during the Disposition Phase.